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East Europe Report

SCIENTIFIC AFFAIRS

No. 741

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CONTENTS

INTERNATIONAL AFFAIRS

Polish-British Coproduction of K-202 Minicomputer Assessed (INFORMATYKA, Sep-Oct 81) 1

CZECHOSLOVAKIA

Nontraditional Livestock Fodder To Save Grain (Vladimir Peter Interview; SMENA, 15 Mar 82) 27

Briefs

Electronic Acupuncture Apparatus Popular 31

ROMANIA

Computer System Development, Industrial Applications Viewed (Mihail Florescu; MAGAZIN, 27 Feb 82) 32

POLISH-BRITISH COPRODUCTION OF K-202 MINICOMPUTER ASSESSED

Warsaw INFORMATYKA in Polish No 9-10, Sept-Oct 81 pp 8-17

[Article: "An Assessment of the K-101 Project"]

[Text] 1. Introduction

The K-202 project was discontinued during the first half of the 1971-1980 decade. Because of the time that has elapsed since then, it is very difficult to make an objective assessment. To overcome this difficulty and to present the most realistic picture possible of this project, the group developed this report primarily on the basis of authentic documents from the 1970-1974 period and a discussion with Eng (master's degree holder) Jacek Karpinski on 22 May 1981.

Based on extensive analyses, the characteristics of the project are presented and the technical, organizational and economic-commercial aspects of the K-202 are examined for their interrelationships. This report is a synthesis of documents provided by institutions and individuals. The synthesis takes into account the realities of the first half of the previous decade. The documents cited and referred to in this report are listed in the attached List of Documents. Other items are presented separately [56]. The documents referred to or cited in the report contain data and are signed.

2. Characteristics of the K-202 Project

2.1 The Initial Phase--1970

On 26 March 1970, Karpinski presented a draft of collaboration with the English firms Data-Loop Ltd and MB Metals [1]. The object of collaboration was supposed to be the K-202 digital computer--a universal modular minicomputer using modern integrated circuits.[1]

A diary containing the proposal was sent to:
--Minister Prof Dr J. Jasicki, vice chairman of the KNiT [Committee for Science and Technology];

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[1] The term "minicomputer" is used most frequently in the documents.

--Eng (master's degree holder) R. Farfal of the PZPR Central Committee;
--Eng (master's degree holder) J. Huk, chief director of the MERA [Automation and Measuring Apparatus Association].

Collaboration with the English firms would involve the sale and service of a digital computer--a modular minicomputer called the K-202. The characterisitcs of this machine were presented in brief, the extent of its applications were cited and the participation of both sides in the realization of the venture, its schedule of completion and the distribution of the production (40 percent to Poland for its own needs on the basis of nonforeign-exchange coproduction, and 60 percent to the English firms) were also presented. All the above problems are presented in a diary in a catchy way. The diary states that Eng J. Karpinski is the designer and that the computer can operate jointly with computers then produced in Poland (the ODRA 1304 and the R-30).

On 4 April 1970, D.H. Lord, director of Data Loop Ltd, wrote a letter of intention to the director of MERA regarding a proposal for collaboration among Data Loop Ltd, MB Metals Ltd and MERA to produce small, modern computers [2]. In this letter, it was stated that Karpinski concluded a contract with Data Loop as a consultant for the design of a new small computer and its software that this project would be considered to be the propoerty of Data Loop, that the first model of the computer to be developed and its software were partially complete, and that the project was scheduled for completion by the end of October 1970.

In this letter, Lord also states that Data Loop has complete confidence in Karpinski and that he must be the leader of this project in all its technical aspects, from the model stage to the production stage and from system testing and software development, and that the organizational arrangement for collaboration must satisfy Karpinski. Then Lord stated that further work on a model and the production of two prototypes should be organized within Poland with the production assistance of MB Metals. The components for the model, prototypes and future production will be sent directly to Poland by MB Metals, and in return the MERA will deliver three complete and pretested systems for each of four complete sets of components it receives (25 percent for Poland, 75 percent for the English firm).

On 4 October 1970, an agreement was signed between MERA and Data Loop Ltd (MB Metals Ltd) concerning the development and production of digital computers. The agreement defines the object of collaboration (work on the development of a model and prototypes and the preparation for production of small modern electronic digital computers for "complementation purposes" as well as for exportation), the schedule for realizing the project (the model--October, 1970; the two prototypes--February, 1971), the volume of production (up to 1973 exclusively), the obligations of both sides, the division of labor to develop software (the English would deliver by the end of October, 1970 the preliminary operating system with a symbolic language translator and library of basic functions, and by the end of April, 1971 a FORTRAN translator; in turn, Poland would supply by the end of April, 1971 an ALGOL translator and a library of standard subroutines); the agreement also specified that Karpinski would lead the development team. This agreement contains a clause stating that Data Loop is obligated to create credit for the purchase of necessary equipment and apparatus needed to produce the model and prototypes. This credit was to be repayed by cash on terms to be arranged. The subsequent stage of collaboration was also specified (after the successful completion of the first stage).

On 30 June 1970, Huk, chief director of MERA, issued official order No 16/Pfn/70 regarding the initiation of production of the minicomputer at the ERA plants as a priority task for MERA. This order specified that the director of the ERA plants:
--create a development-production section for computers;
--present (by 16 July 1970) a detailed schedule for developing and producing a model and prototypes and make preparation for production by the second half of 1971;
--coordinate design principles with Data Loop (by 15 August 1970);
--conclude a commercial agreement with Data Loop via PHZ [Foreign Trade Enterprise] METRONEX;
--appoint Karpinski as chief of the newly created section.

In accordance with this document, Karpinski was designated plenipotentiary technical director of the MERA for initiating the production of minicomputers at the ERA plants, and it also authorized him to contact directly members of the MERA directorate and to speak out, in coordination with MERA's technical director, on matters concerning preparing and initiating production of minicomputers.

At the same time, Karpinski was obligated to develop the microcomputer principles by 15 July 1970 and to present these principles (after coordination with Data Loop) for approval to the MERA technical director; he also was obligated to personally file written weekly reports to MERA's technical director. MERA's directors and sections subordinate to them were obligated to provide optimum help in developing and initiating production of the microcomputers. Based on this order, Z. Miedzychocki, director of the ERA ZWPP [Measuring Instruments Plants], issued on 7 August 1970 Directive DN 33/70 (in force 1 July 1970) regarding the formation within the ERA of a Development-Production Section whose goal was to develop and produce a small digital computer having universal applications. Karpinski was entrusted with the task of director and was employed in this position as of 1 July 1970.

The above formal-organizational activities and documents defined the K-202 project and gave it its form and organizational structure.

The growth in personnel employed in this section was as follows: July 1970--3 people; December 1970--52; July 1971--105; December 1971--128; March 1972--169 [65].

On 9 July 1970, Karpinski obtained the approval of the ZWPP ERA director to continue work as a consultant on computers for Data Loop and MB Metals Ltd up to 30 September 1970 [6].

Based on T. Pajkowski's statement, it can be said that from 1967 to June 1970 (directly from the presented facts) that the group directed by Dr Jerzy

Keszczynski worked on K-202 software, including a simulator of K-202 instructions on the ODRA 1202, the structure of the ASSK symbolic language, and a set of tests to verify the effectiveness of the instructions [21].

Among the mentioned documents, two of them, that is the initial MERA-Data Loop agreement and Official Order No 16/Pfn/70, established the time schedule for realizing the K-202 project, namely [4]:
--to develop a detailed schedule by 15 July 1970;
--to develop the microcomputer principles by 15 July 1970;
--to coordinate the design principles with Data Loop by 15 August 1970.

It is difficult to determine from the available documents if these schedules were maintained; on the other hand, there are no clues that anyone questioned the maintenance of these schedules.

The initial period of work at the ERA sections was dedicated to preparing the development of a model and to organizationsl matters, of which the most important one was the completion of the section's staffing.

2.2 Second Year of the Project--1971

During this period, the first problems associated with realizing the K-202 minicomputer appeared [8]. According to Karpinski, these problems were caused by delays in formal actions (sending a letter to Lord regarding the formation of the ERA section), by delays in ordering Polish peripheral equipment, and by the nonrealization of the previously established schedule for the ODRA 120 to initiate software work, and by the nonrealization of decisions of the council held 16 January 1971 and attended by vice ministers Kuczma (Planning Commission), Kopiec (MPM [Ministry of Machine Building Industry]) and Jasicki (KNiT) and Directors Twardon (MERA), Miedzykocki (ERA), and Karpinski (ERA). At that time it was decided to create the ERA OBR [Research and Development Center] for Mathematical Machines, allocating $150,000 to purchase components, subassemblies and peripheral equipment as well as $650,000 to purchase technical equipment for production in 1972.

A document entitled "Basic Design" and dated 12 October 1969 was sent to the ERA on 7 April 1971.

On 4 May 1971, agreements were signed between PHZ METRONEX and Data Loop, between PHZ METRONEX and MB Metals, and between Data Loop and MB Metals [27, 28, 29]. Among other things, these agreements specified the obligations of both sides concerning software production. Data Loop was obligated to deliver to METRONEX an executive program with an assembler as well as a library of programs for elementary functions, a package of test programs and a library of subroutines (by 31 July 1971) and a FORTRAN compiler (by 30 October 1971). In turn, METRONEX was supposed to supply to Data Loop an ALGOL compiler (by 31 March 1972) and a BASIC compiler (by 31 July 1972). The agreement between METRONEX and MB Metals also called for the delivery of a pretested and fully operational K-202 computer together with its technical documentation by 31 July 1971 [28]. This prototype was delivered 29 December 1971. Delays were not contested by MB Metals. The group did not get the documents concerning the formal transmittal of software specified in the agreement.

By virtue of Official Order No 7 of 31 July 1971, MERA's chief director appointed a commission to research the K-202. The commission demonstrated a working model of the K-202 [9]. After two meetings, the commission decided to terminate its activities since at that stage of their work on the K-202 essential information was lacking to evaluate hardware and software.

On 12 October 1971, within the framework of the agreement of 4 May 1971, a contract was signed between METRONEX and MB Metals to deliver 15 4Kb CPUs (central processing units) equipped with ASR [automated systems] teletypes, an automatic program loader and ASSK, BASIC, FORTRAN, ALGOL and COBOL software with the proviso that the deliveries should be made in 1972 [34]. The time for the delivery of the CPUs designated in the contract was 10-16 weeks after parts and subassemblies were received from MB Metals. It should be noted that COBOL software is also mentioned in the contract, which in general was not anticipated. The contract was signed by MB Metals and PHZ METRONEX representatives and was initialed by Karpinski.

Within the framework of the contract, deliveries were made from March 1972 to July 1972. The group had access to a large number of documents from which it was indicated that its contractors (first the ERA section and then ZDM [Minicomputer Experimental Center] of the IMM [Institute for Mathematical Macines]) had many problems in general in realizing purchase orders mainly for imported components and subassemblies, as well as in obtaining foreign-exchange allotments for these imports. Karpinski placed the blame on MERA (foreign-exchange limits) and PHZ METRONEX (delays in sending out orders and also not sending out orders at all). On the other hand, MERA and PHZ METRONEX accused Karpinski of placing orders directly with Data Loop and MB Metals, ignoring PHZ METRONEX which is in violation of the legal order existing in Poland.

On 14 June 1972, MB Metals sent a telex to PHZ METRONEX regarding research on the three K-202 processor prototypes delivered to MB Metals within the framework of the contract of 12 October 1971 [13]. In addition to the critical remarks in the telex concerning the transmitted units, new conditions were imposed which were beyond the agreement and contract, for example, the delivery of a multiprogram operating system and other software [18]. The group did not receive the document containing the reaction to the content of this telex which was transmitted to the IMM.

2.3 The Third Year--1972

On 22 January 1972, Vice Minister A. Kopiec formed a commission to research and assess the K-202 minicomputer. As a result of its activities, the commission issued a final protocol which was signed 1 December 1972 [22].

On 21 February 1972, Karpinski sent a letter to the MPM [Ministry of Metal Industry] in which he requested a thorough investigation of the matter of improving production conditions for the K-202 minicomputer [61]. In its reply letter, the MERA (via Order No 10 of 3 March 1972 of the Chief Director) designated ZDM IMM as the production plant, based on the Research and Development Section of the ZWPP ERA Mathematical Machines. Available documents indicate that this decision, preceded by preparations to designate an independent production plant, did not normalize the situation regarding filling orders for components and subassemblies to manufacture the K-202. As time went on, official letters and memos concerning foreign-exchange limits and the filling of orders were circulated [56].

Based on Official Order No 12 of the MERA director of 8 July 1982, a commission consisting of representatives from the IMM, ZDM IMM and PHZ METRONEX, met from 13-15 July 1972 to assess the status of export commitments of the K-202 minicomputers realized to date. The commission prepared a protocol which recapitulated the status of the K-202 accomplishments. The protocol contains conclusions of which the most important one for realizing the project is the one about guaranteeing conditions for executing the obligations specified in the contract, and the necessity of MERA to make a decision concerning further financing of K-202 production and the volume of this production [12].

On 1 December 1972, MB Metals requested that PHZ METRONEX supply them 15 K-202 processors [38]. This request was fully accepted by Karpinski [39]. As a consequence of this request, the agreement between PHZ METRONEX and MB Metals concluded 4 May 1971 was terminated [28]. The understanding regarding the termination of agreements and conditions for this termination are presented in a separate document which was signed 22 February 1973 [13]. It was preceded be extensive correspondence in which Data Loop and MB Metals gave signals of much interest in the K-202 and extensive market possibilities as well as about difficulties in collaboration that were encountered during the realization of the K-202 project [67].

Another letter appeared after the agreement with MB Metals was terminated, and individuals and groups appeared before the secretariat of the Central Committee--S. Kowalczyk and J. Szydlek--as well as before E. Gierek suggesting that the K-202 production be continued for domestic user needs [56].

The finale of the K-202 project was the meeting of 10 April 1973 between MPM Minister T. Wrzaszczyk and representatives of the PZPR Central Committee, MERA's chief director and scientific director Karpinski. At this meeting, Minister Wrzaszczyk decided:
--to develop by 15 June 1973 the general principles for a family of minicomputers which take into account domestic needs and utilize the experience obtained from developing the K-202 and other machines;
--to use the results achieved to date and the laboratory potential and experience of the K-202 Group to realize the minicomputer development program; and for its work and accomplishments to date the group would be recognized;
--to produce 30-40 K-202 minicomputers in 1973 from imported material; appropriate funds for supplementary imports would also be allocated;
--to appoint Karpinski to the position of Chief Designer of the ZD [Experimental Center] for Minicomputers.

Then Karpinski was dismissed as the director of the ZD IMM, and attempts were made to induce him to accept the position of chief designer of the ZD IMM. Karpinski did not accept the position. The group started to disband; some found other work, but most of them got involved with producing the MERA 400 minicomputer. These decisions practically and definitely ended work on the K-202 especially development work.

Up to 10 March 1973, 27 CPUs were produced of which 14 had memories of 4K words and 12 had memories of 12K and 16K words. Four auxiliary operating memory modules having capacities of 32K words and 50 controllers for character units were also produced, and the production of three automation channels was also advanced.

3. A Technical Assessment of the K-202 and Its Application Possibilities

3.1 The Basis and Scope of the Assessment

During the 1971-1973 period, the technical assessment of the K-202 was the subject of a number of commissions formed by MERA's directorate and the directorate of the MPM. The technical characteristics of the K-202 minicomputer presented in this work is the synthesis of all the results achieved by all the commissions investigating the matter as well as the opinions of individual specialists.

The work is based on the opinions of:
--the Commission to Assess the K-202 Electronic Digital Computer Program and its Research Results which was formed by MERA's directorate in July 1971 [17];
--an expert called by the commission [17];
--MB Metals on the three K-202 units it received [18];
--members of the group working on the K-202 minicomputer which was issued in conjunction with improving K-202 production [19, 20, 21];
--the Commission to Investigate and Assess the K-202 Minicomputer [22];
--the Commission to Assess the Possibility of ZDM Accepting Data Loop's Order [23, 24, 25].

In the area of hardware, the assessment of the K-202 minicomputer encompasses:
--architecture and logical structure;
--technical level;
--configuration.

In the area of software it encompasses:
--structure of the basic software;
--technology for generating the basic software.

And in the area of assessing applications, it encompasses:
--the trend of potential applications for the K-202 minicomputer.

3.2 Hardware

3.2.1 Architecture and Logic Organization

The Instruction Set

The K-202 instruction set contained 90 instructions realized on the basis of hardware (including 5 floting-point instructions) and 128 extra-coded instructions.

In examining the K-202 processor as a component of a larger computer system to process data, one should remember the lack of essential instructions that are necessary from the viewpoint of such applications as:
--multiplying whole numbers (fixed-point);
--dividing whole numbers (fixed-point);
--converting data from the base-10 system to the binary system and vice-versa;
--operating on alphanumeric characters.

Typical basic operations required two to three contacts with the PAO [operating memory] which meant that the K-202's operating speed could not exceed 300,000 operations per second when using an operating memory having a 1 ps cycle.

The Addressing System and Division of Operating Memory [17, 22]

The K-202's unit of operating memory was a 16-bit word. The accepted addressing system did not permit continuous addressing of memory beyond 64K words. Memory protection was accomplished in blocks of 4K words. To organize operations with an operating memory exceeding 64K words was impossible. The continuous addressing of areas of operating memory above 64K words would have required the realization of special programming

The Input-Output System [17, 22]

The accepted logic design for the memory channels assured off-line data transmission. The character channel transmitted data via the CPU. In this situation the transmission of each character interrupted the operation of the ongoing program. Such an organized transmission caused high usage of the CPU.

A maximum of eight memory channels and eight character channels could be connected to the K-202 minicomputer.

3.2.2 The Level of Technology

The Component Base [22]

The design was based on small- and medium-scale integrated microcircuits. All electronic components and memory modules were imported from Zone II.

Technological Characteristics [19, 22]

--modern production methods were used to produce the K-202 minicomputer which was a densely packed, light and portable design;
--the mechanical design did not assure proper strength or technology of production and service [19];
--the electrical power design did not assure certainty of operation or reliability [19];
--the somewhat low reliability of manufacturing and assembly did not assure proper operation after transport and aging [19];
--the initiation of series production would have required the introduction of necessary design changes to improve the K-202's technological advantages and automation of assembly and control-measuring operations [22].

3.2.3 The Configuration

The K-202 was designed as a modular system consisting of the following components [16]:
--CPU;
--memory channels (up to 8);
--character channels (up to 8);
--operating memory modules;
--external memory devices;
--input-output devices;
--automation channels;
--automation terminal devices.

Connecting peripheral equipment required the development of appropriate control units [15].

At the end of 1972, K-202 prototype number 8 was presented for testing in the following configuration:
--CPU with a 12K-word memory;
--two operating memory modules, 16K words each;
--channels and a configuration of equipment control units;
--operator console (teletype ASR 390);
--perforated tape reader (CT-1001);
--line printer (V-132 C);
--paper tape puncher (Facit 4070);
--X-Y recorder (UCCI).

In 1973 design work was done to include a T 7000 tape memory and a Drico disk unit in the K-202 configuration [23].

3.3 Software

3.3.1 Basic Software Structure [22]

The K-202's basic software included:
--the SOK-1 operating system;
--a BASIC interpreter;
--an ASSK-3 assembler;
--a library of programs.

The SOK-1 operating system was a modular executive program and an interpreter of the control language for single-programming operation. The SOK-1 was of modern design and included a universal package for servicing peripheral equipment.

The BASIC interpreter was a prototype of an interactive programming system.

The ASSK-3 was an elementary sysmbolic language with poor diagnostics. The ASSK did not include equipment to create microdefinitions.

The library of programs included:
--static functions;
--differential and integral calculus;
--algebra;
--analytic functions;
--linear programming;
--optimization.

An analysis of the software contained in [22] was as follows: "The presented K-202 software of the configuration under investigation was incomplete even from the viewpoint of K-202 microcomputer applications. From the viewpoint of treating the K-202 as a universal system, it is only rudimentary. Relative to the software of other minicomputers (for example, the Varian 620) the presented software is poor."

3.3.2 Technology for Generating Basic Software[2]

All elements of the basic software were generated using traditional technology. No supporting resources were used to generate software, such as a generator of XPL compilers, end-to-end compilers and the like. The extensive dispersal of work on the basic software had a negative effect on the time it took to generate it and on its level of reliability. An integrated system of software tests was not developed, and proper control of generated software quality was not organized.

3.4 Trends of Potential Applications

The commission formed 22 January 1972 considered the following K-202 applications to be the preferred ones [22]:
--automation of techological control processes;
--scientific-technical and engineering calculations;
--the gathering, preparation and initial processing of data.

A condition for using the K-202 minicomputer to realize the above applications was to equip it with appropriate peripheral equipment as well as necessary software. It was noted that the K-202 is a necessary complement to the computers produced in Poland (the ODRA 1300 and RIAD 32) [22].

4. An Economic and Commercial Analysis of the K-202 Project

4.1 A recapitulation of the commercial coproduction agreements concluded by MERA and PHZ METRONEX with the English firms:

a) MERA-Data Loop of April 1970 [3];
b) METRONEX-Data Loop of May 1971 [27];
c) METRONEX-MB Metals of May 1971 [28];
d) Data Loop-MB Metals of May 1971 [29].

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[2] As assessed by the group.

4.1.1 On 11 April 1970, the initial agreement between MERA and Data Loop concerning cooperation in the development and production of a minicomputer was signed [3]. This agreement established the following model of cooperation:

A. The English side would assure:
--the design principles of the minicomputer authored by Karpinski, consultant to Data Loop;
--gratuitous subassemblies and material worth up to 25,000 pounds sterling;
--ASSEMBLER language software, a library of elementary function programs and a FORTRAN compiler;
--a market in England for a minimum of 300 units annually.

B. The polish side would assure:
--designing a model and prototypes in Poland by Karpinski's group;
--testing of the prototypes;
--the supervision of Karpinski over the project, from the model stage to the production stage and to the testing and development of software;
--series production to be designated for export after the prototypes were approved.

In addition the sides agreed to sign in the very near future a detailed agreement with the participation of a Polish foreign trade enterprise which would represent MERA's interests.

4.1.2 During the course of realizing these agreements, three commercial agreements were signed on 4 May 1971 [3]:
--PHZ METRONEX and Data Loop [27];
--PHZ METRONEX and MB Metals [28];
--Data Loop and MB Metals [29].

A. The METRONEX-Data Loop Agreement [27]
The subject of the agreement: the K-202 minicomputer was defined as follows: "An original, small computer of advanced design developed on design principles which are the property of Data Loop, having all or some of the following units: a memory-unit processor, memory channels, input-output interfaces and multiplexers."

Data Loop was obligated to:
a) provide the K-202 design principles authored by Karpinski;
b) deliver software (apart from the ALGOL compiler and BASIC compiler);
c) patent the K-202 in Poland and England jointly with PHZ METRONEX and the joint protection of these patents.

PHZ METRONEX was obligated to:
a) produce K-202s under the supervision of Karpinski;
b) pay Data Loop a 5 percent royalty for each K-202 sold outside Poland;
c) together with Data Loop, patent the K-202 in Poland and England as well as jointly protect these patents;
d) give Data Loop the exclusive right to sell the software outside Poland.

B. The METRONEX-MB Metals Agreement

The object of the agreement: "Original K-202 computer being a serially derived family of computers and having all or some of the following equipment: a processor, memory units, memory channels, input-output interfaces and multiplexers."

MB Metals was obligated to:
a) guarantee gratuitous subassemblies and materials worth up to 25,000 pounds sterling;
b) develop a model and prototypes;
c) prepare commercial literature and service instructions;
d) assure the marketing and servicing of the K-202 outside Poland in the following amounts:
--first party--10 units minimum;
--during the second stage, 100-150 units minimum (first year) and 300-1,060 units the second year;
--deliveries in years to follow to be agreed upon.

The second stage would depend on MB Metal agreeing with the technical conditions of the first party of the commercial output (10 units minimum).

PHZ METRONEX was obligated to:
a) develop a K-202 prototype;
b) deliver to the first commercial party a minimum of 10 units;
c) execute orders from MB Metals for the number of K-202 devices specified in the agreement (on the basis of exclusivity).

c. The Data Loop-MB Metals Agreement

Object of the agreement: cooperation in the area of K-202 sales and operations associated with these sales. The K-202 design principles and documentation are the property of Data Loop. Production drawings and technical documentation are the joint property of Data Loop, MB Metals and others. Data Loop will deliver to MB Metals K-202 software. MB Metals will pay Data Loop a royalty of 5 percent for each K-202 sold. MB Metals appoints Data Loop as the subdistributor of the K-202 and its software in the CEMA countries, Finland, China and Yugoslavia.

In summary it should be stated that:
a) At the time the agreements were signed only the following existed: a K-202 model and the design principles authored by Karpinski, being the property of Data Loop. Also from this the formulations are imprecise in defining the technical object of the agreements, and they only define the rights and obligations of the sides in a general way.
b) The concluded agreements are of a provisory nature because they subject the production, development and sale of the K-202 to the realization of an assumed level of export, which in turn is dependent on the acceptance of the prototype by MB Metals and the first commercial party.

4.2 Financial Outlays in Circulation-Type and Foreign-Exchange Zlotys for K-202 Production, an Account of Losses and Profits

According to MERA's declaration (Attachment No 1 to the letter): "During the 1970-1973 period MERA (together with ERZE [expansion unknown] and ZD IMM) spent about 160 million zlotys as well as 3,292,575 KK [capitalist countries] foreign-exchange zlotys on the K-202 project. It is a fact that in accordance with the contract the object of the export to MB Metals was only supposed to be a processor having a 4K memory capacity and not the K-202 minicomputer.

According to the contract, we were supposed to receive from MB Metals $6,200 for each processor with import outlays of about $2,500. The value in zlotys of one processor having a capacity of 4K words was about 250,000 zlotys. It also is a fact that for peripheral equipment purchased from the capitalist countries for the K-202 minicomputer we paid at that time:
--$7,000 for a DRI-31 or CDC 9425 memory disk;
--$5,000 for a Westinghouse 1600 CRT monitor;
--$1,850 for a Facit 4070 tape punch;
--$1,850 for a DYANMIOS 390 teletype.

Thus it can be seen that the prices in foreign-exchange for some peripheral devices were higher than the price for the K-202 which was supposed to be the object of export to MB Metals.

The above 3,292,575 foreign-exchange zlotys were allocated as follows:
--about 75 percent for the purchase of components, subassemblies and peripheral devices for the K-202;
--about 25 percent for the purchase of apparatus and equipment to produce the K-202. But foreign-exchange income was not received from MB Metals by way of compensation for K-202 subassemblies sent to Poland, except for $93,000 for 15 processors having capacities of 4K each.

At the same time, as indicated by MERA's study, in 1972 the computer industry employed 2,692 people while ZD IMM, which was only producing the K-202, employed during this same year 271 people, that is about 10 percent of all the people employed in the branch [31]. The study also indicates that total financial outlays for 1971, 1972 and 1973 for scientific research and application work in the field of technical resources for information science was about 1.51 billion zlotys which means, according to statement [30], that the expended sum of 160 million zlotys represented about 10 percent of total outlays.

Study [31] also indicates that the total value of coproduced imports from Zone II in MERA's Information Science Branch amounted to 24.28 million foreign-exchange zlotys for 1971, 1972 and 1973, and thus the sum of 3,292,575 foreign-exchange zlotys expended in foreign exchange for the K-202 project represented about 14 percent of MERA's total foreign-exchange outlays for coproduction imports during this time period.

According to [31], a total of 28 K-202s were produced of which 15 were exported to England for a total of $93,000 and 13 units were sold in Poland for about 26 million circulation-type zlotys (according to letter [32]. each system cost an average of 2 million zlotys).

An estimate of ZD IMM's profits and losses for the 1970-1973 period in circulation type zlotys is as follows:

outlays --- 160 million
income --- 26 million
profit --- --
loss --- 134 million.

In foreign-exchange zlotys:

outlays --- 3.3 million
income --- 0.3 million
profit --- --
loss --- 3.0 million.

The above estimate of profits and losses is a microscale view, that is it shows that ZDM IMM incurred losses of 134 million circulation-type zlotys and 3 million foreign-exchange zlotys, but it does not answer the basically placed question on the macro scale, on the scale of the entire national economy, namely: Should have this production been continued?

The cited account of profit and losses could have impelled a decision about stopping production, since the losses amounted to 134 million circulation-type zlotys and 3 million foreign-exchange zlotys, and the outlays were at about a level of 10 percent of the branch's total outlays along with a relatively high level of coproduction imports which already amounted to about 14 percent of the coproduction import of this branch's association, but the decionmaker did did not authorize the undertaking of such a decision without taking into account the following decisionmaking elements:

--the technical level of the product;
--realistic prospects for export;
--domestic needs and the anti-import character of the production;
--limits on ownership and patent rights;
--import-intensiveness of the product and embargo limitations.

Only after an analysis of the course for realizing the agreements concluded with the English firms will we be able to completely assume an attitude toward these questions."

4.3 The Course for Realizing the Agreements Concluded with the English Firms

4.3.1 The METRONEX-MB Metals Agreement

In accordance with the METRONEX-MB Metals agreement, a prototype of the K-202 CPU together with documentation and technical drawings needed to prepare commercial literature and service instructions and to service the K-202 was delivered [28]. The prototype was delivered in December 1971, that is several months late. However, in the acceptance report for the prototype, MB Metals stated that the delay was their fault exclusively and was caused by the off-schedule deliveries by this firm of some subassemblies [33].

MB Metals placed an order for the first commercial party--15 K-202 CPUs having 4K capacities. According to the agreement, the delivery was supposed to be of a decisive nature because it would determine the success of the entire project [28].

The detail contract of 12 October 1971 specifically called for the delivery of 15 K-202 CPUs having 4K capacities and costing $6,200 per unit [34]. The deliveries were made on schedule, that is, during the March-July 1972 period. During this time, MB Metals expressed interest in purchasing one complete K-202 microcomputer system, but the order depended on the quality of the 15 CPUs, in accordance with the agreement [28]. On 1 December 1972 MB Metals sent a letter of complaint to PHZ METRONEX in which it stated: "...MB Metals is forced to reject the 15 K-202 CPUs for the following reasons:
1) the lack of restart equipment near the network power-feed sign;
2) the lack of an interface buss;
3) nondelivery of software--the operating system."

At the same time MB Metals stated in letter [35]: "...the fact that we have not obtained completely proficient processors makes it impossible for us to place an order for systems."

In a letter to PHZ METRONEX, the ZDM fully acknowledged the scope of the complaint detailed in MB Metal's letter of 1 December 1972 [35, 36].

The group paid special attention to the technical conditions of the contract of 12 October 1971 regarding the delivery of 15 K-202 CPUs and the fact that Karpinski, ZD IMM director, acknowledged the above-mentioned complaint [31].

The group established the following:
--The contract of 12 October 1971, the commercial as well as technical portions, was signed by METRONEX representative J. Dziewiecki and H. Zukowski, and ZD IMM Director Karpinski, and by C.D. Hinchliffe of MB Metals.

--The technical conditions of the contact anticipated the delivery of ASSK, BASIC, FORTRAN IV, ALGOL (in 1972), and COBOL (1972) software in the cost of the product.

--MB Metal's complaint of 1 December was sent to ZD IMM via METRONEX on 4 December 1972. In its main letter, METRONEX states [38]: "...we request a formal opinion on the justification of the complaint and the feasibility of settling it...."

--In a METRONEX official document, on a copy of the above-mentioned letter, there is a hand-written note by Director Karpinski dated 13 December 1972 which reads as follows [39]: "...we consider the complaint to be justified and accept it. Points 1 and 2 can be corrected in 4 weeks after the defective processors and components needed to rework them are received (cost about 30 pounds sterling per unit). Point 3 can be delivered for verification during the committee reception which we propose to hold in Warsaw."

--In the letter of 16 December 1972 to PHZ METRONEX, Director Karpinski reacknowledged the complaint in its entirety and in addition rescinded the decision regarding point 3 ordering a committee reception in Warsaw.

--PHZ METRONEX did not accept the complaint.

With regard to the unsatisfactory quality of the K-202 first party, MB Metals decided to cancel other purchases. On 22 February 1973 the agreement of 4 May 1971 was terminated [13].

In the existing situation, METRONEX began to actively seek other firms interested in purchasing the K-202. Offers were sent, direct talks with the English firms RACAL and CDC were held, but these firms showed no interest. Also, talks conducted with Data Loop produced no concrete results because this company, having only several employees, had neither a sales network nor any influence on important distributors, nor did they have the means to finance the purchase in which they were interested.

4.3.2 The METRONEX-Data Loop Agreement

--The K-202 design principles were sent by Data Loop to the ERA plants on 7 April 1971.
--The obligation of the firms to deliver software in accordance with point 1a of the agreement was executed and confirmed by Data Loop letter of 22 November 1972 to PHZ METRONEX and reconfirmed by Data Loop letter of 4 May 1973 to PHZ METRONEX [40, 41].

With regard to this, Data Loop cited the written confirmations of Karpinski dated 4 December 1972 which, among other things, gave cause for a lawsuit in an arbitration court in Basel, Switzerland [54].

It should be noted that the IMM, in its letter N/1393/3121/75 dated 15 May 1975 and signed by Director Janicki and Director Karpinski, which was sent to PHZ METRONEX, negates the complete execution of obligations concerning software by Data Loop [43]. In addition, in the record of the matter one finds the statement of Eng Teresa Pajkowska of 13 July 1972 which states that the software was in fact developed in Poland by the group headed by Dr J. Leszczynski (PKP [Polish State Railraods] Center) during the period from 1969 to June 1970 and then from September 1970 by the ERA Plant Group (Department of Mathematical Machines) and not by Data Loop [21]. Because of its inportance, this matter requires additional full explanations to establish the probable losses on the Polish side exclusively.

--Data Loop did not fulfill its contractual obligation to jointly patent the K-202 in Poland and England. On the contrary, Data Loop in concert with Karpinski submitted a patent application on 6 April 1973 to the British Patent Office, ignoring PHZ METRONEX. During the arbitration process in Basel, Switzerland, Data Loop submitted a letter on this subject matter to Data Loop which was dated 18 January 1975 and signed by Karpinski which authorized this firm to unilaterally apply for patents and thus ignoring the Polish side [45]. The contents of the letter in its original [English] form is as follows:

"I hereby confirm that in contravention of the Agreement between Metronex and Data Loop wherein my position as Director and Executive controller of the project was clearly stated, I was dismissed from my post on very short notice without any valid justification being given.

"Subsequently I was offered the alternative position of 'Chief Constructor' which I refused to accept as not in keeping with the original conditions accepted by all parties at the commencement of the project. The position of Chief Constructor embraces the leadership of design only, without executive authority for policy which is vested in the Directors of the Factory for Minicomputers ZDM.

"The Chief Constructor has no control over the production activities nor any decisive voice in investment policy.

"At the time of my dismissal, I concurred with the opinion of Data Loop Ltd that the Agreement relating to the K-202 project had been effectively broken by the Polish side and, therefore, with Data Loop's decision not to add the name of Metronex to the final submission of patent applications in London until such time as the situation was rectified."

Because of its seriousness, this matter, like the matter of software, requires additional explanations to determine the losses of the Polish side exclusively and at the same time to explain the circumstances of the patent applications. By virtue of the legally valid provision of the judgment of the Administrative District of the City of Warsaw regarding the case of IMM against Karpinski on returning the patent application plan drawn up in 1972 by the patent agent Zygmunt Palka and encompassing [46]:
a) the method of coding instructions in digital computers;
b) the parallel interface of electronic digital computers;
c) the electronic system of a digital machine;
Karpinski was obligated to give to the IMM in Warsaw the application plan. In addition the court ordered Karpinski to give to the IMM the documents described in point 1 within 7 days of the implementation of the judgment [46].

The group established that Data Loop and Karpinski filed patent application No 16684/5/73 in Great Britain on 6 April 1973 with a complete technical description of the invention on 3 July 1974 (that is after the judgment of the Administrative District Court in Warsaw) and on 20 July 1977 obtained patent numbers 1,480,209 and 1,480,208 [48]. The group stated that this matter requires additional investigation and explanations. During the life of the agreement, Data Loop did not sell a single K-202 minicomputer and did not have a sales organization or financial resources. The firm's initial capital was only 2,000 pounds sterling. On 12 February 1973 this firm placed an order with PHZ METRONEX that was not secured financially (No DL/Mtx/KTK/001/73 of 12 March 1973) for three K-202 systems worth a total of 23,730 pounds sterling with delivery to be made in an exceptionally short time span [49]:
--the MDK 001 system -- end of April 1973;
--the MDK 002 system -- mid-May 1973;
--the MDK 003 system -- in April 1973.
ZDM IMM did not confirm the above-mentioned order for realization.

An analysis of the course of cooperation with Data Loop indicates that this firm concentrated most of its activities in the Polish market, seeking Polish orders for subassemblies and peripheral equipment designated for the K-202, and in association with this many orders were placed with the firm directly by Director Karpinski, ignoring PHZ METRONEX, which made it impossible to verify prices paid and their negotiation [54].

Of the 3.3 million foreign-exchange zlotys spent for imports to realize the K-202 project, Data Loop obtained 326,000 pounds sterling, that is about 2.3 million foreign-exchange zlotys or about 70 percent of the total sum spent.

Thus, it was not so much in the interest of Data Loop to export K-202s from Poland as it was to sell K-202s in Poland because this firm lived on the sale to Poland of subassemblies and peripheral devices for the K-202. It should be emphasized here that the Metronex-Data Loop agreement did not give this firm any rights in this matter [27].

Data Loop practically became a monopolistic supplier to Poland of the abovementioned equipment because of its exclusive right to represent the producers, as typified by Karpinski, and as a result of directly placing orders with this firm via Karpinski.

In a letter dated 26 July 1972, Director J. Kulesz writes to Director Karpinski [50]:

"The revisions made in your plant indicated that they are not in compliance with the decisions resulting from the guidelines concerning the import of machines and equipment initiated by the administration of the Ministry of Foreign Trade. Equally onerous was the direct ordering by you from foreign suppliers of equipment and material as well as their receipt without the knowledge and agreement of PHZ Metronex. Along with this, it should be emphasized that such a practice makes it difficult to verify the actual status of deliveries and to execute bilateral clearing of accounts. In view of the negative effects of your practices in this area, MERA was forced to issue appropriate verification instructions."

In its letter of 22 May 1972 to the KBI [National Office of Information Science] which was signed by Director Karpinski, concerning the sending of foreign exchange to import external and peripheral equipment for K-202 systems, the ZD IMM asked for a guarantee of foreign exchange amounting to $481,000 (that is about $50,000 for each K-202 system) to import equipment produced by Data Dynamics, Facit, Westinghouse, Wang, Centronics, Racal, Thermonic and BASF. For the most part, these firms were represented in Poland by Data Loop. Attempts, which were naturally time consuming, by PHZ METRONEX to change this state of affairs by seeking out other sources of suppliers and negotiating for lower prices were made impossible by constant pressure to accelerate the system of supply contracts and the allegations of sluggishness in contracting for equipment and subassemblies from Data Loop.

The high import-intensiveness of the K-202 (about $1,930 for each PCU having a memory capacity of 4K words, invoice value of $6,200), plus the almost

100 percent import-intensiveness of peripheral equipment subordinated production to the embargo policy of the U.S. Department of Commerce, especially in the area of MM-4-1 matrix memories produced by Data Products. The American authorities demanded information concerning the use of these matrices and the nature of the users [52].

Then Data Loop tried to create a model of collaboration which would assure it of complete control over the design, production and marketing of the K-202 hardware and software by virtue of:
--possession of the design principles developed by Karpinski;
--possession of the patents by unilaterally applying to the British Patent Office with the agreement and participation of Karpinski;
--possession of the software developed in Poland on the order of Karpinski;
--assuring control for itself over the importation of subassemblies to produce the K-202 by obtaining the right of exclusivity for Poland from the producers, attempting to create a mechanism to order the above-mentioned components directly via Karpinski while ignoring PHZ METRONEX.

The above statements allow one to understand the essence and genesis of the arbitration process brought about by Data Loop against PHZ METRONEX after K-202 production was discontinued.

4.4 Recapitulation of the Data Loop Arbitration Process Against PHZ METRONEX in Basel, Switzerland [54]

In accordance with the contingencies described in point 10 of the agreement of 4 May 1971, on 28 February 1977 Data Loop brought suit against PHZ METRONEX in the Arbitration Court in Switzerland to obtain a judgment for damage for the following amounts [27]"

a) [Following in English]

1)	Air fares, hotel, travel and incidental expenses (including visits of Polish personnel to the U.,.) up to 31/12/75	pounds sterling	
	D.H. Lord	6,736	
	J. Karpinski	1,254	
	A. Jenkins	558	
	Mrs L. Granleese	150	
	L.C. Hawken	462	
	A.B. Roberts	120	
			9,280
2)	Ditto since 1/1/76		
	A.B. Roberts	550	
	D.H. Lord	1,000	
			1,550
3)	Consultancy fees		
	J. Karpinski	13,500	
	A. Jenkins	3,000	
			16,500

4)	Hardware, software, components and tools	3,000	
	Software development costs (other than FORTRAN)	1,500	
			4,500
5)	Exhibition and E. European travel (other than Poland)	2,000	2,000
6)	FORTRAN compiler	7,000	7,000
7)	Components ordered by UNITRA as agent for METRONEX for use in K-202 by ZDM	5,000	5,000
8)	Legal costs	5,000	5,000
9)	Proportion of telex, telephone and other direct administration costs on K-202	2,500	2,500
			53,330

b) General damage being loss of royalty on sales of K-202 by main distributor, loss of profit on sales of K-202 and peripheral equipment to Data Loop and loss of profit on sales of K-202 software by Data Loop.

1) Loss of royalty on main distributor's sales:

Minimum unit sales envisaged in preliminary proposals dated 1 April 1970 being 1,680 units adjusted over 7 years; and minimum sales units envisaged in agreement dated 4 May 1971 between METRONEX and MB Metals being 1,600 units adjusted over 7 years; average net price of K-202 units (as defined in 1971 agreements) being 3,000 pounds sterling; minimum value of K-202 sales being therefore 12.8 million pounds sterling Data Loop royalty at 5 percent is

640,000

2) Loss of profit on sales of K-202 peripherals by Data Loop:

Data Loop being in negotiation for business of a gross value of approximately 800,000 pounds sterling on February 1973; and Data Loop having the reasonable prospect of gross sales totalling additionally 2 million pounds sterling during the currency of the agreements of 1971; and Data Loop obtaining an average net profit of 5 percent on such sales, its total loss of profit would be

120,000

3) Loss of sales of K-202 software by Data Loop:

Data Loop having a reasonable prospect of gross sales of a value not less than 100,000 pounds sterling during the currency of the agreements of 1971; and Data Loop obtaining an average net profit of 20 percent on such sales its loss of profit would be

	20,000
	780,000
Total	833,000

[End English]

Data Loop complained that PHZ METRONEX:
1. Caused the termination of the agreement with MB Metals by delivering poor-quality equipment;
2. Dismissed Karpinski as plant director;
3. Discontinued K-202 production.

During the long process, METRONEX proved that it bore no responsibility for the termination of the agreement with MB Metals and the withdrawal of this firm from further collaboration. METRONEX never recognized MB Metal's letter of complaint, delivered good-quality products in accordance with the contract, and the repairs made by the producer (ZDM IMM) and its acknowledgement of the complaint did not make further collaboration impossible. METRONEX proved that this matter cannot be an object of dispute between Data Loop and PHZ METRONEX. The termination of the MB Metals-METRONEX agreement occurred with the approval of Data Loop and Data Loop's claim in this matter is baseless. Since Data Loop claims PHZ METRONEX terminated the agreement, then why does it not make the same claim against MB Metals?

METRONEX proved that Karpinski used his official position to take a number of actions that benefited Data Loop and he did not fulfill his duties as the plant director, and in addition:
--developed the design principles for the K-202, which are the property of Data Loop and which contain basic errors in the construction of the list of instructions which made the delivered software worthless and made it necessary for the Polish side to start work all over again;
--ordered a much greater assortment and number of peripheral devices from Data Loop than was necessary for design and development activities;
--ordered equipment from Data Loop for which the firm had exclusive sales rights as an agent despite the act that these devices were not constructively perfected;
--ordered equipment incompletely (without additional equipment) which could not be used quickly and effectively;
--acted in behalf of Data Loop, using the producer's employees for this purpose;

--harmed ZDM IMM by concealing the actual costs for developing the FORTRAN IV translator ordered by Data Loop, showing its cost to be 5 percent of the true cost (in effect, the reason for the symbolic sum of 7,000 pounds sterling was to procure the FORTRAN IV translator with the right to sell it);
--applied for K-202 patents at the British Patent Office which is in violation of the agreement of 4 May 1971 between PHZ METRONEX and Data Loop and in defiance of the Polish court's judgment of May 1974.

In addition, METRONEX stated that the above activities, including the actions benefiting Data Loop, justified the dismissal of Karpinski as ZDM IMM's chief director and that offering him the post of chief designer was included in the decisions of the agreement of 4 May 1971. Karpinski did not accept the offer.

METRONEX proved that K-202 production was undertaken as an export project requiring the close collaboration of the three interested sides. The withdrawal of MB Metals from collaboration, the lack of real interest from other firms, Data Loop's financial and organizational-marketing inability to distribute the K-202 on a large scale, and embargo difficulties led to the cancellation of this production because it represented a source of foreign-exchange drain for the Polish side, a pump sucking out foreign exchange from Poland mainly for the benefit of Data Loop which, in an illegal manner, patented the K-202's basic technical design with the approval of Karpinski as verified by his letter of 18 January 1975 to Data Loop in which he stated that the Polish side broke the agreement and thus authorized Data Loop to apply for patents [45]. In this situation, the Polish side was forced to stop K-202 production.

On 12 January 1979, the Arbitration Court in Basel, Switzerland issued a judgment in which it was adjudicated that [54]:
--the MB Metals-METRONEX agreement was terminated 21 February 1973 with the approval of both sides;
--negotiations between Data Loop and PHZ METRONEX concerning further collaboration continued to the end of 1973;
--on 21 July 1974, Data Loop advised PHZ METRONEX that it intended to take the matter into arbitration in accordance with point 10 of the agreement;
--on 28 February 1977, Data Loop stated precisely in its suit its claim for 833,000 pounds sterling, presenting its accusation relative to PHZ METRONEX on the basis of the agreement concluded 4 May 1971 [27];
--the concluded agreements of 4 May 1971 do not authorize Data Loop to present the claims contained in the suit;
--PHZ METRONEX protected its rights and discharged its obligations resulting from the concluded agreements;
--in the agreement, Data Loop did not assure for itself its rights regarding the eventual return by METRONEX of incurred actual costs, instead it was a commercial risk for Data Loop;
--Data Loop's claim concerning presumed losses (lucrum cessans) is without any legal basis at all, even though this firm has a moral right to a certain amount of remuneration for transmitting to PHZ METRONEX the K-202 design principles, know-how and software, even if it was in the form of participation in the process costs.

In conclusion, the court dismissed Data Loop's claim, and the processing costs were covered jointly by both sides, equally shared. This judgment is legally valid and cannot be abrogated.

5. Conclusions

Below are the conclusions resulting unequivocally from the presented analyses. All of them can be justified by virtue of the considerations made in points 1-4 of the report which were quoted or by virtue of the opinions of the group after analyzing the documents. The group was unable to obtain answers to all the questions that arose. The less important questions were omitted and the important ones are presented at the end of this section.

The following eight conclusions were reached:

--the technical characteristics of the projected K-202 computer which were presented in 1970 were comparable with equipment then being produced in the world (point 2.1, point 3.2);
--the commercial agreements signed by PHZ METRONEX with Data Loop and MB Metals were the basis for export production, but the continuation of the project depended on the evaluation of product quality of the first part by MB Metals (point 2.1, point 4.1). The evaluation was negative [35];
--the directives issued by the directorate of PiAP MERA and its subordinate units were the basis for initiating K-202 production (point 2.1), in accordance with the assumptions of Document 1 issued by Karpinski, as a priority MERA task;
--the assumptions presented in 1970 regarding the K-202 and the production timetable were optimistic [1]. The investigations made in 1973 showed that these assumptions were not fully realized (point 2.1);
--the K-202 copies were manufactured from parts that were for the most part imported. The peripheral equipment with which the K-202 configuration was equipped were also imported (except for the CT 1001 reader). K-202's internal memory contained imported MM-4-1 matrices produced by Data Products (the United States) which were affected by the embargo [52]. The license to import this part contained limits on quantities (point 3.2) and also required Poland to provide information on the sale and installation of each K-202 configuration.

With K-202 series production, the group believes that the exchange of imported subassemblies from Zone II for subassemblies manufactured in Poland lowered K-202 quality regardless of the virtues of the model;
--the realization of the project in the framework of the commercial agreements with MB Metals and Data Loop lagged behind causing discouragement and apprehensions on both sides, and the K-202 minicomputer did not achieve the assumed technical parameters;
--the negative assessment made by MB Metals of the first party for the 15 K-202 processors that was expressed in the letter of complaint of 1 December 1972 caused the termination of the agreement with MB Metals on its initiative [35, 38, 39]. This wrecked the export character of the project;
--the patenting of two important K-202 features in Great Britain by Karpinski and Data Loop can have legal consequences for the Polish side in case the patented design is used in the future (point 4.3).

The group was unable to provide details on the basic software produced in Poland that was procured by Data Loop (point 4.3.2).

The group cannot assume an attitude toward the patent problems (point 4.3.2), which in light of documents [47, 49, 54] require further explanations and investigations by institutions called on to do so.

The group cannot assume an attitude toward the legal problems concerning the simultaneous employment of Karpinski by Polish and English firms.

List of Documents

[1] The production of minicomputers in collaboration with English firms. Initial assumptions, 26 March 1970, signed: Engineer J. Karpinski.
[2] Letter of intention from the director of Data Loop Ltd., D.H. Lord, to the director of MERA, Engineer J. Huk, 30 June 1970.
[3] Initial agreement between MERA and Data Loop signed by Engineer J. Huk and D.H. Lord.
[4] Official Order No 16 Pfn/70 of the Chief Director of MERA, Engineer J. Huk, 30 June 1970.
[5] Instruction DN 33/70 of the director of the ZWPP ERA of 7 March 1970.
[6] Letter from ZWPP ERA Director to Engineer J. Karpinski of 9 July 1970 expressing agreement on continuation of work as a consultant for Data Loop and MB Metals.
[8] Official memo from Engineer J. Karpinski of 25 February 1971 regarding the realization of the K-202 minicomputer.
[9] Official Order No 7 of 31 July 1971 from the chief director of MERA regarding research on the K-202 digital computer (together with two statements from the Commission).
[11] Instruction No 10 of the chief director of MERA of 8 March 1972 concerning the recall of ZDM IMM.
[12] The protocol of the Commission to Assess the Realization of Export Obligation concerning the K-202 Minicomputer, dated 11 July 1972.
[13] Agreement on terminating the agreement between PHZ METRONEX and MB Metals of 22 February 1973.
[14] Resolutions resulting from the meeting with Minister of the Machine Engineering Industry T. Wrzaszczyk held 10 April 1973.
[16] Protocol resulting from the meeting of 10 September 1971 at the MERA Plants of the Subcommittee to Assess the K-202 Program and Research Results that was formed by the MERA director in July 1971.
[17] T. Kamburelis: "Initial Opinion on the Logical Organization of the K-202 Digital Machine," Wroclaw, 16 September 1971.
[18] The opinion of MB Metals on the three K-202 units it received (TELEX of 14 June 1972).
[19] E. Jezierska, A. Ziemkiewicz: "Notes on the First Party of the K-202 Machine," Warsaw, 15 August 1972.
[20] Szanswer, W.: "Notes on the Software of the First Party of the K-202 Machine," Warsaw, 16 August 1972.
[21] T. Pajkowska: "Memo Concerning K-202 Software," Warsaw, 13 July 1972.
[22] Final protocol of the Commission to Investigate and Assess the K-202 Minicomputer formed by the MPM under secretary of state, Eng A. Kopiec, dated 22 January 1972, Warsaw.

[23] Protocol of the Commission to Assess the Possibility of ZDM Realizing Data Loop's Order formed by the IMM director on 22 February 1973, Warsaw, 1 December 1972.

[24] K. Jaroslawski, A. Ziemkiewicz: "Notes on Protocol [23]," Warsaw, 2 March 1973.

[25] Protocol from the meeting of the Commission to Assess the Possibility of ZDM IMM Realizing Data Loop's Order concerning the notes of K. Jaroslawski and A. Ziemkiewicz, Warsaw, 3 March 1973.

[27] METRONEX-Data Loop agreement of 4 May 1971.

[28] METRONEX-MB Metals agreement of 4 May 1971.

[29] Data Loop-MB Metals agreement of 4 May 1971.

[30] MERA letter to the Committee on Information Science of 21 April 1981 identified as TC/36/81.

[31] MERA paper entitled: "The Computer Industry During the 1971-1980 Period," April 1981, Warsaw.

[32] ZDM IMM letter of 16 December 1972 to MERA identified as ES/1096/72.

[33] METRONEX-MB Metals protocol of 29 December 1971.

[34] Contract No 31-322/0-0037/1 of 12 October 1971.

[35] MB Metals letter of 1 December 1972.

[36] ZDM IMM letter to PHZ METRONEX of 16 December 1972.

[38] PHZ METRONEX letter 322/0-0037/1-GB/E to ZDM IMM, 4 December 1972.

[39] J. Karpinski handwritten note of 13 December 1972.

[40] Data Loop letter to PHZ METRONEX of 22 November 1972.

[41] Data Loop letter to PHZ METRONEX of 4 May 1973.

[42] J. Karpinski's statement of 4 December 1972 concerning generating the software.

[43] IMM letter N/1393/3121/75 to PHZ METRONEX of 15 May 1973.

[45] J. Karpinski's letter to Data Loop of 18 January 1975 concerning patents.

[46] Judgment of the Warsaw District Court of 7 May 1974 Sygn. act III C-916/74.

[47] British patent No 1,480,209 of 20 July 1977.

[48] British patent No 1,480,208 of 20 July 1977.

[49] Data Loop order DL/MTX/KTK/001/73 of 12 March 1973.

[50] Letter from IMM Chief Director R. Kulesz (DN/2988/PZ) to J. Karpinski of 26 July 1972.

[51] ZDM IMM letter ES/263/72 to KBI of 22 Mary 1972.

[52] PHZ METRONEX letter 322/5-3001 to IMM of 17 May 1975.

[54] Process documentation of the Arbitration Court in Basel, Switzerland. Group of documents in the Archives, PHZ METRONEX.

[56] List of documents not cited in the report, May 1981.

[60] MB Metals telex to J. Karpinski regarding the ordering of parts for the prototype, signed by Alan Jenkins.

[61] J. Karpinski's letter to the Minister of the Machine Engineering Industry of 21 February 1972, signed by J. Karpinski.

[65] MERA document sent to the group, April 1981.

[67] MB Metals letter (no addressee) of 2 August 1972, signed by M.J. Lanham.

[68] Data Loop letter to Prof J. Kaczmark of 11 August 1972, signed by D.H. Lord.

[69] MB Metals letter to Director J. Huk of 20 September 1972, signed by M. Lanham.

[70] Data Loop letter to Engineer J. Karpinski of 20 December 1972, signed by D.H. Lord.
[71] Data Loop letter to Director J. Karpinski of 12 February 1973, signed by D.H. Lord.
[72] Memo to Director A. Ziaj of 12 February 1973, signed by D.H. Lord.
[73] COPE letter to D.H. Lord of 15 March 1973, signed by B. Bignell.
[74] K-202 memorandum of 31 March 1973, signed by D.H. Lord.
[75] Data Loop letter to Director A. Ziaj of 24 May 1973, signed by D.H. Lord.
[76] Data Loop letter to J. Karpinski of 22 May 1973, signed by D.H. Lord.
[77] MB Metals letter to PHZ METRONEX of 21 August 1972, signed by MJ Lanham.
[78] MB Metals letter to DH Lord of 11 November 1972, signed by MJ Lanham.
[79] Data Loop letter to J. Karpinski of 5 March 1973, signed by DH Lord.

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NONTRADITIONAL LIVESTOCK FODDER TO SAVE GRAIN

Bratislava SMENA in Slovak 15 March 82 p 3

[Interview with Doc Dr Vladimir Peter, CSc, of the Institute of Farm Animal Physiology of the Slovak Academy of Sciences, employed at the Agricultural College in Nitra, and researcher Jozef Huba, by Adela Strbkova: "Waste Used as Animal Feed"; date and place not specified]

> [Text] Among large so-called pollutants of the environment are large-scale breeding farms, whether they are raising hogs or poultry. As concerns poultry production, in recent years that has increased in volume as well as size of farms, in some places several hundredfold, in others up to a thousandfold. But a new problem has arisen directly in proportion with this--what to do with poultry dung? After all, its production exceeds egg production threefold and the volume of poultry meat even fivefold. It is not surprising that the problem of disposing of poultry droppings had begun to involve research centers too. Here it is primarily the Institute of Farm Animal Physiology of the Slovak Academy of Sciences in Ivanka pri Dunaji. We talked about this in more detail with nonresident specialist of the institute, Doc Dr Vladimir Peter, CSc, employed at the Agricultural College in Nitra, and with researcher Eng Jozef Huba.

[Question] Among research projects with the objective of utilizing waste materials from agriculture and industry containing nutrients for feeding farm animals, you are working on, among others, an interesting problem--making use of excrement, in this case poultry droppings, as food for beef cattle. I know, however, that this is not at all unprecedented. Even here, poultry dung has, in the past, been used as feed.

Vladimir Peter: The idea of using poultry droppings as feed for livestock was taken up here in Czechoslovakia back at the beginning of the 60's, being the first in the world. We selected this method of disposition because it seemed to us the most effective utilization of all those valuable substances that are still concealed within poultry excrement in considerable measure. On our recommendation, drying chambers for the droppings were built here at large poultry farms even then. But after 1970, when energy costs increased, the drying of poultry dung had become uneconomical. And so the feed program ended.

[Question] You mentioned the high content of valuable substances in poultry dung. What are these?

Vladimir Peter: Poultry droppings are not at all undesirable wastes as often appears to be the case. After all, after being dried they still contain an average of about 30 percent nitrogenous substances. That is more than in dried alfalfa. They also contain a large amount of mineral substances and trace elements such as zinc, manganese and iron which are often deficient in feeds. Poultry dung has a high vitamin content, especially the B group, mostly B-12. When we were experimenting with dried poultry dung back in 1960-62, we found it sufficed to add 5 percent to it to the feed mix for broiling chickens and this covered the total requirement of this vitamin for baby chicks. Nor is the high content of vitamins A and E negligible. From all this, it was evident that we ought to look into the possibility of using poultry droppings in place of soybean extracted grits which we are importing in large quantities from capitalist countries for foreign exchange. And this opportunity still presents itself today.

[Question] Of course, today we have to consider the energy situation and look for some other method than that used 20 years ago--so, some other technology for its treatment.

Vladimir Peter: We are fully aware of that. Under present conditions, it became evident that the cheapest and at the same time most efficient form of disposition, or better said, treatment of poultry dung and poultry litter was ensilage together with corn or other bulk fodder. Eng Huba is working on this problem.

Jozef Huba: I would like to add that corn compensates for those substances which are lacking in poultry dung. Poultry dung, as Docent Peter stated, has a relatively high content of nitrogenous matter which is indispensable for beef cattle production. But it has relatively low energy value, as opposed to corn which is relatively high in it. In our experiments, we are trying to find the optimal proportion of corn to poultry dung, or, in essence, between energy value and nitrogenous matter. Then we ensilage this mixture, that is, induce fermentation without access to air. What we want is to find the best method of ensiling.

[Question] The dung, as such, however, contains, besides the nutritive elements mentioned by Docent Peter, also a quantity of various bacteria which might harm the cattle.

Jozef Huba: The results of tests have shown that by following proper procedures of ensilage all disease-producing bacteria are definitely destroyed. There is a certain problem in the onset of certain kinds of molds but we detected their presence only on the surface layers which also occurs in standard ensilage in current use. It suffices to remove 10 to 15 centimeters of the top layer and underneath everything is all right.

[Question] And what is the quality of this kind of silage?

Jozef Huba: Samples of silage composed of chopped corn and poultry dung or poultry litter have been found by the State Veterinary Institute to be harmless to the health in all respects. Under the point system, most of the silage was classified as first quality. In feeding tests with this type of silage, cattle for fattening showed moderate weight increases.

[Question] Your objective, obviously, is to have the results of the testing program put into practice as soon as possible after its completion. Would you be able to say, at this point, what would be the savings and the effect on our national economy by using feed with poultry dung?

Vladimir Peter: The annual production of nitrogen agents from poultry dung represents 300,000 to 400,000 tons annually here in Czechoslovakia. If we were to take out only one-third of this for feeding beef cattle it would replace so much bulk fodder that we could free some 10,000 hectares of land to permit cultivation of such crops as soybeans or various legumes for direct human consumption. We would thereby significantly contribute to self-sufficiency in food production. At present, agricultural production is reaching a state in which animals are competing with man. We are using a large part of our land to produce fodder. Arable land should be used primarily to grow crops for people.

[Question] All the more so since today's knowledge actually makes it possible to replace fodder proteins grown on land by nontraditional proteins such as poultry dung.

Vladimir Peter: Yes. Just as a matter of interest, if, according to calculations, we were to utilize all nontraditional raw materials with nutritive content to feed farm animals we would save 400,000 to 800,000 hectares of arable land here in Czechoslovakia. After all, poultry dung need not be the only source of feed for livestock. There is also the waste from meat processing and other animal production. Dead animals, waste material from leather working, proteins produced by nicro-organisims or even larvae of household flies which, after drying, make suitable feed, fully equal to soybean extracted grits.

> Many of these sources of feed sound quite unusual to us now. But we must realize that conditions for the production of food are considerably different from those of several decades ago. And if we do not want animals to compete with us in food consumption we must make use of those feeds for their sustenance that are not sources of food for humans. Of course, this calls not only for better application in practice of the findings of science and technology but also changing our attitude toward livestock nourishment, and getting rid of traditional customs. And we should also change our notion that proper farm animals worthy of consideration as food are only the large animals. In fact, the animals that convert feed

into protein most advantageously are neither beef cattle, nor hogs, but broiling chickens. One of the main tasks of all humanity is to eliminate the conflict and competition between man and beast. We would thereby eliminate the shortage of land, the need to import protein feeds and we would assure self-sufficiency in food from our own resources and thereby the main objective charged to the agricultural and food industry complex by the 16th CPCZ Congress would be met.

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BRIEFS

ELECTRONIC ACUPUNCTURE APPARATUS POPULAR--A new portable electronic acupuncture apparatus Stimul 3 was recently exhibited at the 13th Brno Trade Fair Consumer Goods Exhibition. The apparatus which is produced by Tesla Eltos enterprise in Liberec has no traditional acupuncture needles, weighs 250 g, operates on a 9-Volt battery and costs Kcs 900. The plant expects to produce about 30,000 units during 1982, but orders from Great Britain alone have reached 100,000. Stimul 3 reportedly alleviates several medical problems, among these toothache, migraine, pains attributed to rheumatism and colds, gall-bladder attacks, spinal pain, insomnia and constipation. The General Manager of Tesla Eltos Liberec M. Sevcik gave his testimony on effectiveness of Stimul 3 saying: "Only God knows how many treatments I took for my spinal problem and what an incredible amount of medicines I took. But I feel like a newborn after the electronic accupuncture treatment." [Prague SVOBODNE SLOVO in Czech 30 Apr 82 p 4]

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COMPUTER SYSTEM DEVELOPMENT, INDUSTRIAL APPLICATIONS VIEWED

Bucharest MAGAZIN in Romanian 27 Feb 82 pp 1, 2

[Article by Mihail Florescu, secretary of state minister, National Council for Science and Technology]

[Text] The accelerated development of the Romanian economy depends on the qualitative improvement in economic activity as a whole, and on greater economic efficiency in all sectors of material production, through automation, and robotization, of technical processes, improved management, as well as the introduction and application of computer methods and techniques, and of data processing and computer technology, an area in which computers play an important role.

If the fundamental feature of the technical and scientific revolution is automation, which controls the operation and self-regulation of installations, and if the computer is the heart of automation processes, then it can be categorically stated that modern development as a whole is moving toward the generalized introduction of computers in all areas of technologic, economic, and social activities.

Computers are universal machines capable of automating a mill, analyzing ancient texts, translating, and so on. The use of digital techniques, microprocessors, and computer technology to process and transmit data, will fundamentally change the concept of automation systems, heralding new, unconventional systems of automation applications, such as: conventional man-machine systems, systems for information automation and transmission using lasers and optical fibers, automation systems for exploiting new sources of energy, and so on.

Through automation, the human functions of effort, observation, memory, and decision, needed to direct a group of operations, are replaced with the functions of technologic devices which perform the same role by technical means, on the basis of previously established, fixed programs. For instance, the development of the first Romanian process computer, the Felix C-32 P, has led to automatic process control systems. The first system was installed at the Hoghiz Cement Factory. Other systems were subsequently installed in cement factories, thermal generation plants, petrochemical installations, and so on.

The technology of the machine building industry, requiring a large number of installations and equipment scattered over large areas, involves the use of a centralized control and monitoring system by means of process computers, which collect, store, and process production information.

Recently, in the chemical industry, at the Craiova Combine for Chemical Fertilizers, the facilities which produce ammonia from methane have used structured systems for technical process management, the M-100 P and M-40 P. The computer system consists of an Independent-100 (256 Kbytes) minicomputer, four ECAROM-800 devices (with integrated microprocessors), and six alphanumeric displays controlled by their own microprocessors.

The economic results obtained from maintaining maximum synthesis yield for the ammonia, and from controlling the purge rate in the ammonia synthesis section, are manifested in a 3 percent increase in the annual capacity of each installation, with reduced consumptions of raw materials and energy.

The main functions of process computers in cement factories are: centralized monitoring of major technical parameters, periodic processsing of information obtained from raw material loads, raw material analysis, periodic calculation of raw material loads to obtain the desired quality of mixtures (cement powder), and so on. On the basis of this information, the process computers directly control the reference values of raw material flow regulators.

Felix C-32 process computers were also installed with 330 MW power generators, in power distribution systems, and so on. Comprehensive automation installations have also been exported to DRG (for 100 and 500 Gcal/h water boilers), Egypt (the Hamrawein Phosphate Combine), Iran (the Tabriz Tractor Factory), Pakistan (the Karachi Refinery), and so on.

Computer technology, like other advanced technologies, has undergone a sustained development with growth rates higher than those of other industrial branches. During 1980 for instance, production was four times higher than in 1975, and in accordance with the Directives of the 12th Party Congress, it will grow 2.3-2.4-fold during the 1981-1985 period. The revolution created by integrated circuits, and by microprocessors in particular, has had a considerable influence on the architecture of computers, which can be divided into four classes:

1. Microcomputers built around a microprocessor, and most recently on a single silicon wafer. They are generally incorporated into a product or system, which is routinely used without awareness of its presence;

2. Minicomputers, which are generally oriented toward a specific application;

3. Computers, from the smallest to the very largest, designed to solve a large variety of problems;

4. Supercomputers that are extremely powerful and characterized by very high computing speeds.

During the 1976-1980 five-year plan, Romania has built the FELIX 512/1024 intermediate/high capacity computer, the CORAL and INDEPENDENT-100 minicomputers, the FELIX MC 8/80 minicomputer, and so on.

The field's orientation for the 1981 five-year plan takes into consideration the progress of computers throughout the world, and the extensive applications of computers for raising labor productivity, optimizing energy balances, saving raw and other materials, and so on. The following directions will be followed: a new generation of computers, the FELIX C-8000 series, will be introduced; the minicomputer family will be expanded with three new types of high productivity devices; microcomputer configurations will be diversified by orienting and incorporating their applications into a wide range of industrial products and complex installations; office and pocket calculators will be added; data collection and entry will be increasigly shifted to magnetic supports, gradually replacing paper and electromechanical devices; billing and accounting machines will be of modular construction with microprocessors and a new technology; and so on.

Plans exist for a more extensive introduction of computer technology in industrial production, keeping in mind Nicolae Ceausescu's indications to the workshop of computer specialists. This will be aimed at optimum management and efficient control of production (primary data collection and processing, manufacturing in optimum batches, control of stocks and specific consumptions); numerical control of machine-tools; automatic tracing and cutting in various industries; computer-aided design; and so on.

Similar plans are made to introduce Romanian computer technology in the service sector. For instance, electronic devices will be used for inventory and cash in stores, restaurants, hotels, the Savings and Loan Bank, and for tourism and transportation rerervations. During 1981-1985, 97 percent of the country's computer technology installations will use domestic-production equipment.

World research is aimed at the production of computers that are easier to use, such as those programmed in conversational languages rather than computer and compiler ones. Also being sought are voice or written--or both--computer outputs. These achievements will make it possible to extend the use of computers to users without special training. In software, systems are being designed which will be capable of recognizing alphanumeric characters or the meaning of some sentences, and which will obey the commands of users.

Magnetic bubble memories are a promising development for reducing the size and increasing the capacity of memories. After the announcement of this discovery by Bell Laboratories in 1967, research carried out in various countries has been aimed at greater integration and higher memory capacities, while reducing the diameter of the magnetic bubbles.

The broad scale introduction of programmed-control machines has created a contradiction between the possibilities raised by automation devices and the characteristics of apparently simple operations which are now being performed by man (loading and unloading, transportation between operations, painting, welding, and so on). To resolve this newly created situation, research has produced industrial robots, which today have penetrated deeply into industry and have become diversified over several generations. The latest types of robots are equipped with a great variety of sensors which can detect light, pressure differences, torques, and so on. Robots are controlled with microcomputers and microprocessors, and can recognize parts during assembly, select some of them, and within certain limits, carry out assembly, dismantling, and mounting.

In the words of Professor Mihai Draganescu: "Robots are articulated manipulators (artificial arms) + sensors + programs + computers." ("The Second Industrial Revolution," p 33).

Industrial robots are automatic handling devices with universal applications; they have several degrees of freedom and can perform motions that are mutually independent under synchronous control. They can be powered hydraulically, pneumatically, or electrically. Robots are programmed by memorizing successive positions initially performed by an operator, and called "learning." In this form of control they do not require a special language, which considerably reduces the dimensions of the control equipment and does not require specially qualified personnel. The Bucharest Polytechnic Institute has built an industrial robot for the Semanatoarea enterprise, and one for the Tourism Bus Enterprise. The Timisoara Polytechnic Institute has built two robots for Resita ICM (Installation and Construction Enterprise) (an electric one and a pneumatic one); the Iasi Polytechnic Institute has built a hydraulically operated robot, and so on. The Central Institute for Machine Construction has built an industrial prototype for a 6.3 daN industrial robot in cartesian coordinates, and a complex configuration with a CORAL minicomputer. Work is also being carried out for a 25 daN industrial robot in cylindrical coordinates.

The trend for the next decades is toward the installation of robots in all mechanical processes, in the machine industry, in textiles, lumber, technical handling processes, raw materials, finished products, and controlled services.

On the basis of domestic efforts, computer technology will increase the economic, technical, and scientific development process in our country, keeping pace with the demands of the contemporary world.

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